SUBSURFACE EXPLORATION AND FOUNDATION RECOMMENDATIONS PROPOSED WASTEWATER TREATMENT PLANT MURPHYSBORO, ILLINOIS

Prepared for:

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SUBSURFACE EXPLORATION AND FOUNDATION RECOMMENDATIONS

PROPOSED WASTEWATER TREATMENT PLANT MURPHYSBORO, ILLINOIS

1.0 Introduction

The City of Murphysboro is planning construction of a new waste water treatment plant near their existing plant southwest of Murphysboro, Illinois. This report provides a summary of the subsurface exploration and engineering recommendations for foundation design of the proposed new facility. Mr. Harold Sheffer with J.T. Blankinship and Associates authorized this project on May 1, 2008.

2.0 Scope and Purpose of Report

The purpose of this geotechnical exploration is to determine subsurface conditions at the specific locations of twelve soil borings, conduct field and laboratory tests to gather data necessary to perform an evaluation of the subsurface conditions, and prepare engineering recommendations relative to the following items:

- Subsurface conditions encountered in the soil borings, including material types to be expected at existing grades and their impact on the construction scheme.
- Site preparation considerations relative to the subsurface conditions.
- Foundation support for the proposed waste water treatment structures, including acceptable bearing pressures, anticipated bearing levels, and settlement estimates.
- Floor slab support and construction.
- Anticipation and management of ground water during construction.
- Soil material and compaction requirements for support of the proposed structures.
- Seismic design recommendations for design of the facility.

- Lateral soil pressures acting on the proposed subsurface walls.
- Presence of mining activity as indicated on the Illinois State Geological Survey underground mine maps.

3.0 Site Description

This site is located on the south side of Riverside Park Road in Murphysboro, Illinois. The site lies south of the existing waste water treatment plant location. This site was vegetated with grass and trees during our field exploration. The topography is level to gently sloping down toward the Big Muddy River that lies south of the site. Ground surface elevations range from 380 to 390. The enclosed Boring Location Diagram indicates the borehole locations.

4.0 Project Description

The new treatment facility will consist of a control building, bar screen, grit chamber, sludge filter building, storage building, two digesters, two aeration basins and two clarifiers.

The control building will have plan dimensions of about 30 by 44 feet, with a finished floor slab elevation of 388.25. The sludge filter building will have plan dimensions of about 40 by 60 feet, with a finished floor slab elevation of 388.25. The storage building is 34 by 56 feet and has a finished floor slab elevation of about 381.

The bar screen will have a bottom elevation of 393, and a water level of about 396. The grit chamber has a bottom elevation of 381 and a top of wall elevation of 395.5.

The aeration basins, clarifiers, and digesters have the following elevations:

Structure	Top of Wall	Bottom	Water	Ground Line
Digester	397	380	395	381-386
Aeration Basin	390.2	370.2	388.2	386-388
Clarifier	384.5	361.3	382.5	382-383

These are circular concrete structures that will be built into the ground. All of the treatment structures are constructed with reinforced concrete, and are full of water.

The structures are located at this site as indicated on the Boring Location Diagram.

5.0 Field Exploration

From May 16 to 22, 2008, we drilled twelve soil borings at this site. Boring locations were staked by J.T. Blankinship and Associates personnel.

5.1 Drilling and Sampling Procedures

The soil borings were drilled with a CME 750 all terrain drill rig. Conventional 3.25 inch inside diameter hollow stem augers were used to advance the boreholes. Representative soil samples were obtained on 2.5 and 5.0 foot intervals employing split barrel sampling procedures in accordance with ASTM D-1586. Upon completion of drilling, the boreholes were backfilled with the soil cuttings.

5.2 Field Tests and Measurements

The following field tests and measurements were performed during the course of exploration activities at the site:

- Ground water readings were obtained during and upon completion of drilling at all soil boring locations.
- Standard penetration tests were performed and penetration resistances recorded during the recovery of all split barrel samples.
- Approximate measurements of undrained shear strength were taken on all cohesive soil samples with a calibrated hand penetrometer.
- All samples were visually classified, according to the Unified Classification System, by the boring technician in preparation of the field boring logs. The samples were then placed into glass jars for transport to our laboratory.

The field test data and measurements are summarized in the Boring Logs located in the appendix to this report.

6.0 Laboratory Tests

In addition to the field exploration, a laboratory-testing program was conducted to determine additional engineering characteristics of the foundation subsoils. All tests were performed in accordance with applicable ASTM specifications. The laboratory-testing program included the following tests:

6.1 Natural Moisture Content

Natural moisture content determinations were performed on all samples. Moisture content determinations aid in estimating the settlement potential of a soil strata. The in-situ moistures also yield information as to the workability of a soil type. Moisture content results are graphically presented on the Boring Logs.

6.2 Visual Classifications

All soil samples were visually classified by the geotechnical engineer in accordance with the Unified Classification System. The visual classifications are noted on the Boring Logs.

6.3 Unconfined Compressive Strengths

Cohesive soil samples were subjected to unconfined compressive strength tests. Unconfined compressive strengths are used to determine the maximum allowable bearing capacity of a soil. Results of the compressive strength tests are plotted on the Boring Logs.

6.4 Atterberg Limits Determinations

Atterberg limits tests were performed on typical soil samples. These tests determine the liquid limit, plastic limit, and plasticity index of the soils, which are used to estimate settlements and classify the soils. These tests are tabulated in the Appendix to this report.

6.5 Sample Disposal

The soil samples are stored in our laboratory for further analysis, if desired. Unless notified to the contrary, the samples will be disposed of six months after the date of this report.

7.0 Subsurface Conditions

The types of subsurface materials encountered in the soil borings are briefly described on the Boring Logs in the appendix to this report. The general characteristics are described in the following paragraphs. The conditions represented by these test borings should be considered applicable only at the test boring locations on the dates shown. It is possible the conditions encountered may be different at other locations or at other times.

7.1 General Subsurface Profile

The subsurface profile at this site consists of about six inches of topsoil overlying four to seven feet of brown mottled gray silty clay to clay (CL to CH classification). Below the silty clay lies a gray mottled brown to brown mottled gray fat clay (CH) that overlies a fat gray clay (CH). A sand deposit was encountered below 54 feet in Borings #7 and #11.

7.2 Brown Mottled Gray Silty Clay to Clay

The upper four to seven feet of brown silty clay is firm to stiff, with unconfined compressive strengths ranging from 0.9 to 2.5 tons per square foot, averaging 1.6 tsf. Moisture contents vary from 24 to 41 percent, averaging 30 percent. The Atterberg limits tests indicate these soils have a liquid limit of 48.1 percent and a plasticity index of 22.2. These soils have a medium settlement potential.

7.3 Brown to Gray Clay

The fat clay has unconfined compressive strengths ranging from 0.6 to 2.5 tons per square foot, averaging 1.6 tsf. Moisture contents vary from 27 to 54 percent, averaging 37 percent. The gray clay below this stratum is the same soil type, with unconfined compressive strengths ranging from 0.4 to 2.9 tons per square foot, averaging 1.2 tsf. Soft strengths were encountered between about 20 and 35 feet in several of the soil borings. Moisture contents vary from 24 to 66 percent, averaging 40 percent. The liquid limits of these fat clays range from 53.8 to 71.5 percent, with plasticity indices of 33.8 to 47.1. These soils have a relatively high potential for shrinkage and swell due to moisture content variations.

7.4 Sand

The sand was encountered near the bottom of Borings #7 and #11 at about 54 feet deep. Standard penetration test values of the sand range from 3 to 14 blows per foot, averaging 8 bpf. Moisture contents vary from 21 to 45 percent, averaging 35 percent.

7.5 Ground Water

Ground water was encountered at depths ranging from 5 to 24 feet in depth during drilling operations. After 48 hours, the water levels range from about 5 to 8 feet below the existing ground line.

7.6 Undermining

Mine maps available from the Illinois State Geological Survey indicate this site has not been undermined. Therefore, mine subsidence does not appear to be a concern at this location.

8.0 Grading Considerations

8.1 Site Preparation

All topsoil should be stripped from the location of the proposed structures. The topsoil should be stripped to approximately six inches in depth and wasted or used to grade landscaped areas of this site. Any tree roots should also be grubbed and wasted.

Due to the high silt content of the upper soils at this site, we highly recommend the site grading operations be performed during hot, dry seasons of the year. The silty clay will tend to pump and rut when wet, resulting in possible removal and replacement with loss of stability.

Upon stripping the topsoil it is recommended the exposed subgrade in areas to support above-ground structures be proofrolled. During proofrolling operations, isolated areas that pump or rut should either be disced and aerated, or excavated from the site and replaced. Upon drying any pumping soils encountered, they should be compacted to a minimum of 95% of the maximum standard laboratory dry density as determined by ASTM Method of Test D-698.

8.2 Fill Placement

After stripping topsoil and proofrolling the subgrade, fill soils may be placed to grade the building pads. The upper low-plastic silty clay soils encountered at this site in areas to be excavated for the subsurface structures will provide acceptable fill material if treated with Code "L" lime. We recommend 5% (by weight) be incorporated into these soils prior to placement as fill material. It is recommended the lime treated fill soils are placed in maximum eight inch loose lifts, with each lift compacted to a minimum of 95% of the standard laboratory dry density. The fill material should be placed within three percent of its optimum moisture content.

A sufficient number of in-place field density tests should be performed by an engineering technician to evaluate the contractor's performance during fill soil placement and compaction. The tests will also aid in determining whether project specifications are being met. A minimum of four compaction tests per every lift are recommended, with not less than one test per 5,000 square feet of fill material.

8.3. Subsurface Excavations

The fat clayey subsoils encountered in the upper thirty feet of the borings are firm to stiff, however shoring and bracing of the excavations or overexcavation on a slope will be required for the deeper structures that encounter the loose sandy soils. Sand seams and lenses were encountered in the fat clay soils at various depths. The sandy soils may tend to slough when excavated on a vertical face. Based upon the soil strengths, the subsurface profile at this site may be classified as a Type B profile. However, due to Type C profile consisting of submerged soils, this site may have a C profile if the ground water is at a relatively high elevation. These classifications are per the Department of Labor 29 CFR Part 1926 OSHA Excavation Rules.

8.4 Subgrade Preparation of Floor Slabs

Environmental conditions and construction traffic often disturb even a well-prepared soil surface at the final grade elevation. Provisions should be made in the construction specifications for the contractor to restore the subgrade soils to a stable condition prior to placing the granular mat. Backfilling of utility trenches is often accomplished in an uncontrolled manner, leading to cracking of floor slabs and pavements. We recommend the utility trenches be backfilled with acceptable fill in eight inch loose lifts and compacted with piston tampers to the project requirements.

The concrete floor slabs may be supported upon a six-inch layer of free draining granular material. Generally, Illinois Department of Transportation Type "A" CA-7 or CA-11 crushed limestone is used in Southern Illinois for this purpose. This is to provide a capillary break and a uniform leveling course beneath the slab.

8.5 Ground Water Control

Footing excavations for structures near the existing ground line should experience few ground water problems. However, deeper excavations will probably encounter ground water. In these excavations, the contractor should make provisions for temporary drainage through the use of sumps and interceptor ditches.

9.0 Engineering Recommendations

9.1 Storage and Treatment Buildings

The proposed storage and treatment buildings may be supported upon shallow spread footings. If founded at a minimum depth of approximately 2.5 feet below the existing ground line, the footings may be dimensioned using a maximum net allowable soil bearing pressure of up to 2000 pounds per square foot. It is recommended the footings have a minimum width of 24 inches to avoid a punching type failure of the foundation. A minimum depth of 30 inches for the shallow footings is recommended for frost protection.

Settlements of a 50 kip column load are estimated at about 1.3 inch, with differential settlements of approximately one inch. The subsoils at this site are highly plastic, and will tend to shrink and swell with variations in their moisture contents.

9.2 Bar Screen and Grit Chamber

The bar screen and grit chamber structures walls will extend to about three feet above the existing ground line, with bottom elevations of about 380 to 392. These structures may be supported upon shallow spread footings dimensioned using a maximum net allowable soil bearing pressure of up to 2000 pounds per square foot. Due to the weight of these structures being less than the weight of the soil excavated, settlements are estimated to be less than 0.5 inch.

9.3 Aeration Basins and Clarifiers

The aeration basins are to be circular structures with top elevations of 390.2, a bottom elevation of about 370.2, and water elevations of 388. The existing ground line elevations range from 386 to 388 in this area.

The clarifiers are structures with top of wall elevations of 384.5, bottom elevations of about 363, and water elevations of 382.5. The ground elevation in the vicinity of these structures is about 382 to 383.

These structures may be supported upon spread footings dimensioned using a maximum net allowable soil bearing pressure of up to 1500 pounds per square foot. Due to soft, marginal soils encountered below the bottom of these structures, two feet of soil at the bottom of the excavations should be overexcavated and replaced with two lifts of 3" minus graded (CA-2 or equivalent) crushed limestone. The crushed limestone should be placed in two 12 inch lifts, with each lift compacted to the engineer's satisfaction with a vibratory roller. The crushed stone should provide a stable base for workers, and may bridge over the softer subsoils.

As with most of the in-ground structures at this site, settlements are estimated at less than 1.0 inch due to the weigh of the structure being less than the weight of soil excavated to construct the basin or clarifiers.

9.4 Digesters

The digesters are structures with top of wall elevations of 397, bottom elevations of about 382, and water elevations of 395. The ground elevation in the vicinity of these tanks is about 381-386.

The digesters may be supported upon spread footings dimensioned using a maximum net allowable soil bearing pressure of up to 1500 pounds per square foot. As with the aeration basins and clarifiers, two feet of soil below these structures may be excavated and replaced with a three inch crushed limestone if poor soil conditions are encountered at these depths. The three inch crushed stone will provide a stable platform to work on, and provide good support for the floor slab.

Although the borings indicate most of the subsoils are adequate for support of the proposed structures, there is the possibility of encountering soils with less than the required bearing pressure. We recommend all foundation subsoils be tested for bearing capacity prior to placement of concrete. Should soils with less than the specified bearing capacity be encountered, it is recommended they be excavated and replaced with a properly compacted granular fill soil or lean concrete.

9.5 Seismic Design

Based upon the seismic design criteria provided by the AWWA, this site has a site classification type "E" profile for shallow footings founded on the clayey soils. Based upon the "E" profile, the spectral response acceleration coefficients have been determined as follows:

0.2 Second Period: S_s = 1.10 g x 0.9 (Soil Factor F_a) = 0.99

1.0 Second Period: S_1 = 0.30 g x 2.8 (Soil Factor F_v) = 0.84

The recommended design spectral response factors are as follows:

S_{DS} = 0.66 g

S_{D1} = 0.56 g

These values were obtained from the AWWA Publication D100-05.

9.6 Subsurface and Retaining Wall Design

Coefficients for active and passive pressures acting upon subsurface and retaining walls in the upper fifteen feet of this site are estimated as follows:

Coefficient of Active Pressure:	0.42
Coefficient of Passive Pressure:	2.37
Coefficient of At-Rest Pressure:	0.59

The clayey subsoils encountered on this site have a wet soil density of approximately 120 pounds per cubic foot.

It is recommended the subsurface walls be backfilled with a free draining sand or crushed stone up to within one foot of the final ground line.

The recommended coefficient of friction between the concrete and soils which may be used for design is 0.33.

9.7 Floor Slab Design

The proposed concrete slabs on grade may be designed using a modulus of subgrade reaction estimated at approximately 100 psi per inch. The soil subgrade beneath the upper floor slabs should be properly proofrolled or compacted per the recommendations in Section 8 of this report.

If movement of the upper slabs near the existing ground line is of concern, the soils one foot below the slab may be treated with Code "L" lime. We estimate 5% (by weight) Code L lime is incorporated into the subgrade. After tilling the Code L lime into the subgrade, the lime-soil mixture may be compacted to a minimum of 95% of the maximum standard laboratory dry density per ASTM Method of Test D-698. The lime will reduce the plasticity of the upper soils, which should decrease the potential for the soil to shrink and swell.

9.8 Hydrostatic Resistance

Any deep structures (below 10 feet in depth) at this site should be designed to allow for drainage of the subsoils from below the floor slab and around the subsurface walls with perforated drain pipe. The drainage pipes should be installed below the floor slabs and around the deep structure walls, draining to a sump or allowed to gravity drain. The pipes should be backfilled with a clean crushed limestone, wrapped with filter fabric.

As an alternative to subsurface drainage, the structures may be constructed with exterior "anchors" sized to resist the uplift pressures using the weight of backfilled soils holding the structure in place. These anchors are usually constructed integral with the structure foundations.

10.0 Summary

This subsurface exploration has been conducted at the site of a proposed wastewater treatment facility plant in Murphysboro, Illinois. This report has been prepared for the exclusive use of J.T. Blankinship and Associates for the specific application to this project.

Design and construction criteria have been suggested and potential problems have been discussed.

The following information has been discussed in this report:

- Soils encountered on the site consist of a few inches of topsoil overlying brown mottled gray silty clay to clay. Below the silty clay lies gray mottled brown to brown mottled gray fat clay (CH) that overlies a fat gray clay (CH).

- Site grading will include stripping topsoil, grubbing the tree roots, and grading the site in areas that will support shallow structures.

- Deep structures will require over-excavation or shoring of the excavations per the OSHA requirements.

- Foundation design criteria have been discussed, and allowable soil bearing pressures have been recommended for shallow spread footing foundations and footings for the subsurface structures.

- The spread footings may be dimensioned using maximum net allowable soil bearing pressure of up to 2000 pounds per square foot for shallow foundations at this site, and 1500 psf for footings founded on the deeper subsoils.

- Due to marginal soils encountered below about ten feet in depth, if soft or unstable subsoils are encountered in the deeper excavations during construction, two feet of 3" minus crushed limestone may be placed and compacted in the bottom of the excavation to provide a stable working surface and support for the floor slabs.

- Earthquake design criteria indicates the recommended design spectral response factors are S_{DS} = 0.66 g and S_{D1} = 0.56 g. This site has a type "E" subsurface profile.

- Coefficients of horizontal earth pressures have been presented for the subsurface structural and retaining wall designs.

The analyses, conclusions, and recommendations contained in this report are professional opinions based on the site conditions and project scope described herein. It is assumed the conditions observed in the exploratory borings are representative of subsurface conditions throughout the site. If during construction, subsurface conditions differ from those encountered in the exploratory borings are observed or appear to be present beneath excavations, we should be advised at once so that we can review these conditions and reconsider our recommendations where necessary. Unless specifically noted, the scope of our services did not include an assessment of the effects of flooding and natural erosion of creeks or rivers adjacent to the project site.

If there is a substantial lapse in time between the submittal of this report and the start of work at this site, or if site conditions are changed due to natural causes or construction operations, we recommend that this report be reviewed to determine the applicability of conclusions and recommendations considering the changed conditions and time lapse.

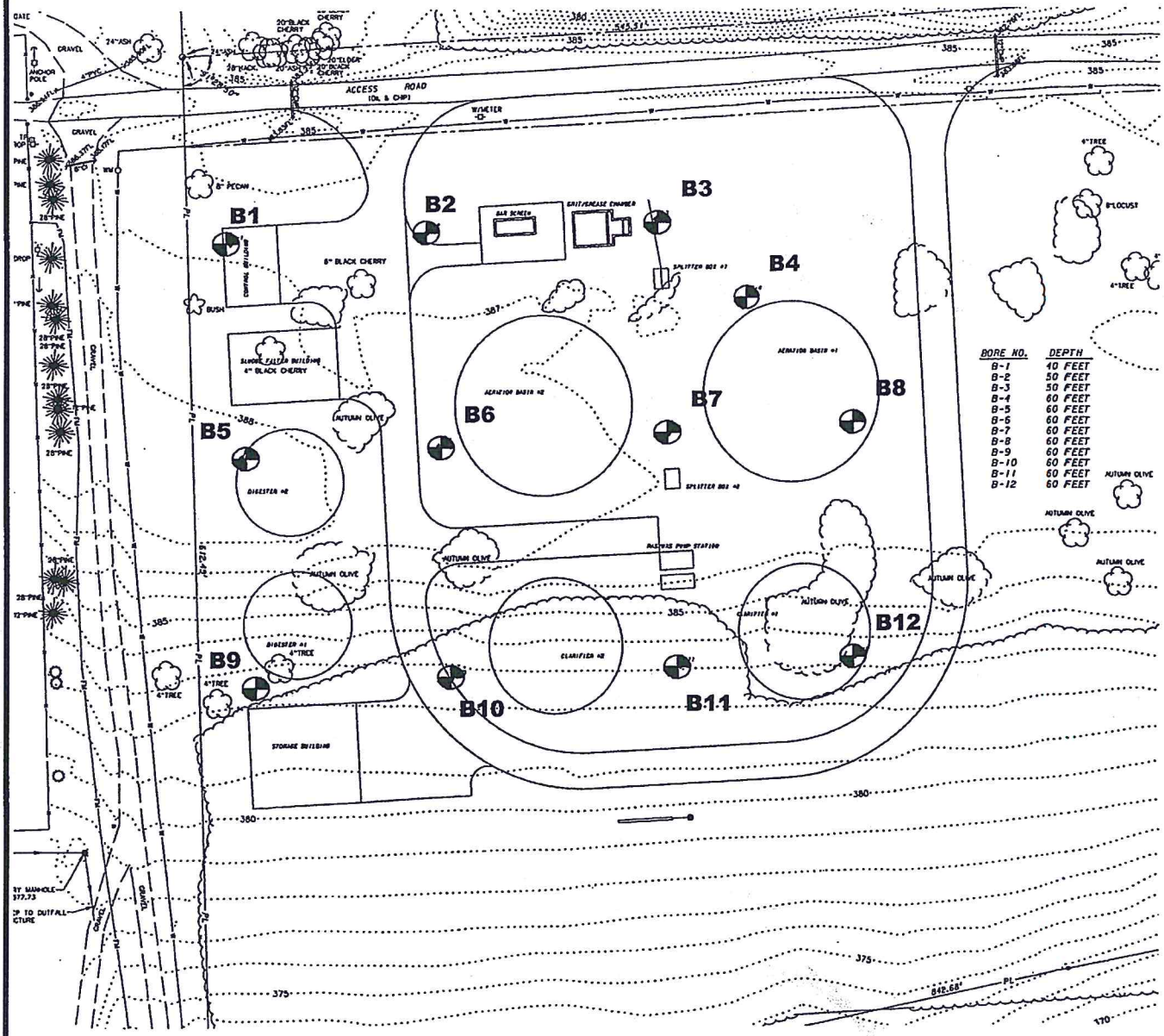
In order for us to provide a complete professional geotechnical engineering service, we should be retained to observe construction, particularly site grading, earthwork and foundation construction.

The scope of our services for this phase of the project does not include any environmental assessment or investigation for the presence or absence of wetlands or hazardous or toxic material in the soil, surface or ground water or air, on or below this site. Any statements in this report or on the boring logs regarding any odors or unusual or suspicious items or conditions observed are strictly for the information of our client.

This report was prepared for the exclusive use of the owner, architect, or engineer for evaluating the design of the project as it relates to the geotechnical aspects discussed herein. It should be made available to prospective contractors for information on factual data only and not as a warranty of subsurface conditions included in this report. Unanticipated soil conditions or rock may require that additional expense be made to attain a properly constructed project. Therefore, some contingency fund is recommended to accommodate such potential extra costs.

It is recommended that we be retained to review final project layout and those portions of plans and specifications which pertain to foundations and earthwork to determine if they are consistent with our findings and recommendations.

Timothy J. Holcomb, P.E.



Proposed Waste Water Treatment Facility **Murphysboro, Illinois** **J.T. Blankinship & ASsociates** **Murphysboro, Illinois**	**Boring Location Diagram**	**Project No. H-08086** **Not to Scale** **May 22, 2008**

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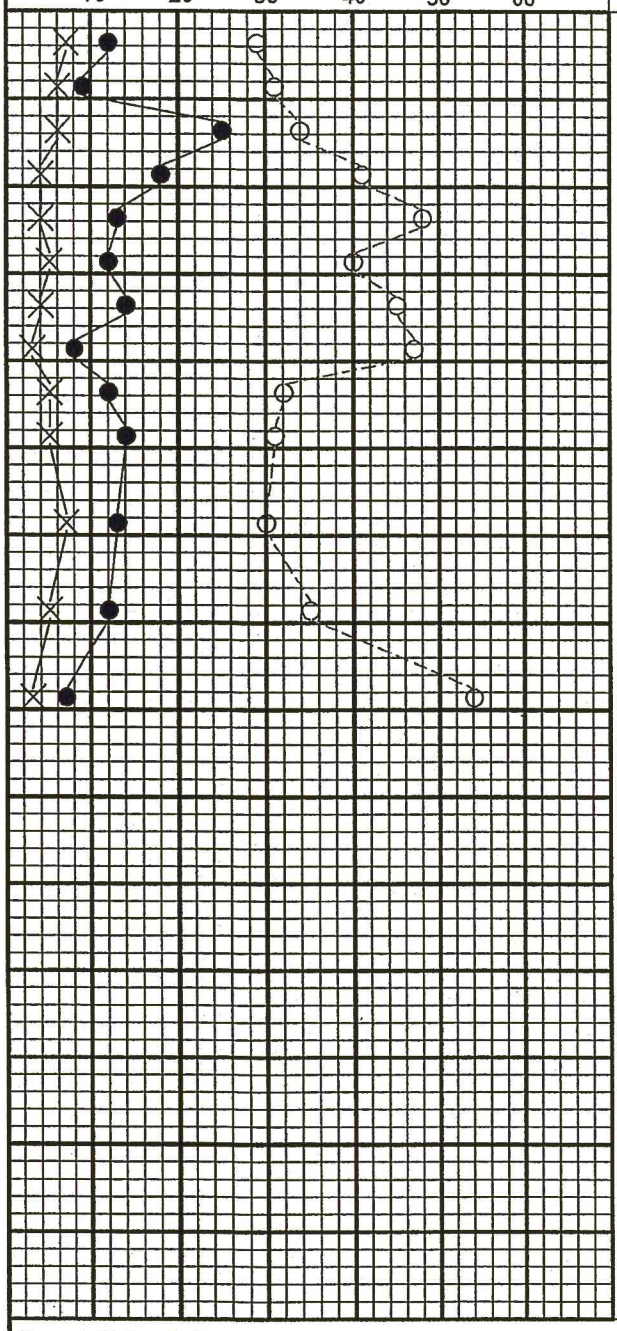
PO Box 88 Carbondale, Illinois

LOG of BORING 1



Depth in Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation
				6" Topsoil
	1	ss		Brown Mottled Gray Silty CLAY to CLAY(CL-CH)
	2	ss		
	3	ss		Gray Mottled Brown CLAY (CH)
10	4	ss		
	5	ss		Gray Mottled Brown CLAY (CH) with sand
	6	ss		
	7	ss		Gray Mottled Brown CLAY (CH)
20	8	ss		Gray CLAY (CH)
	9	ss		
	10	ss		Gray CLAY (CH) with sand lenses
30	11	ss		
	12	ss		
	13	ss		
40				End of Boring @ -40.0'
50				
60				
70				

Ground Water Data
Ground Water Encountered @ -21.0' During Drilling and @ -6.0' after 48 Hrs.

Project: Proposed Waste Water Treatment Facility Murphysboro, Illinois	Date of Boring May 16, 2008
Client: J.T. Blankinship & Associates Murphysboro, Illinois	Project No. H-08086

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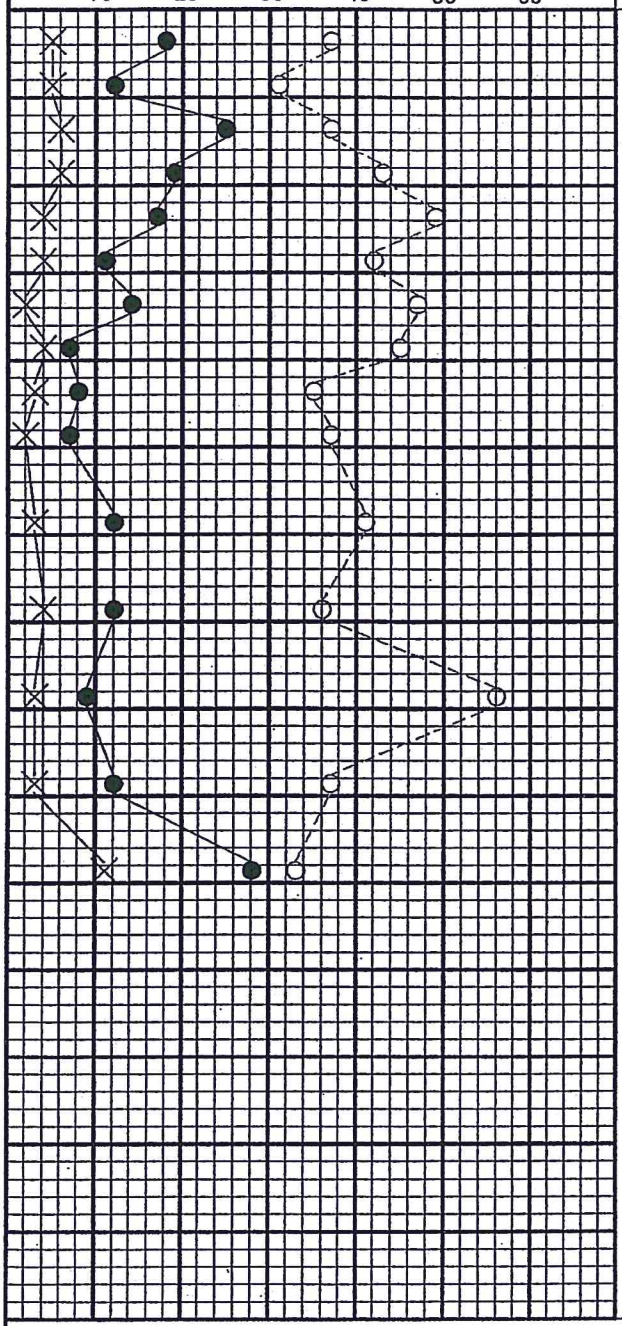
LOG of BORING 2



Depth in Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation
	1	ss		Brown CLAY (CL–CH) with sand
	2	ss		Brown Mottled Gray Silty CLAY to Gray Mottled Brown CLAY (CH) with sand
	3	ss		
10	4	ss		
	5	ss		
	6	ss		Brown Mottled Gray CLAY (CH) with sand
	7	ss		
	8	ss		Gray CLAY (CH) with sand lenses
20	9	ss		
	10	ss		
	11	ss		
30				
	12	ss		
	13	ss		
40				
	14	ss		
	15	ss		
50				End of Boring @ –50.0'
60				
70				

Ground Water Data
Ground Water Encountered @ –20.0' During Drilling and @ –8.0' After 48 Hrs.

Project: Proposed Waste Water Treatment Facility Murphysboro, Illinois	Date of Boring May 16, 2008
Client: J.T. Blankinship & Associates Murphysboro, Illinois	Project No. H–08086

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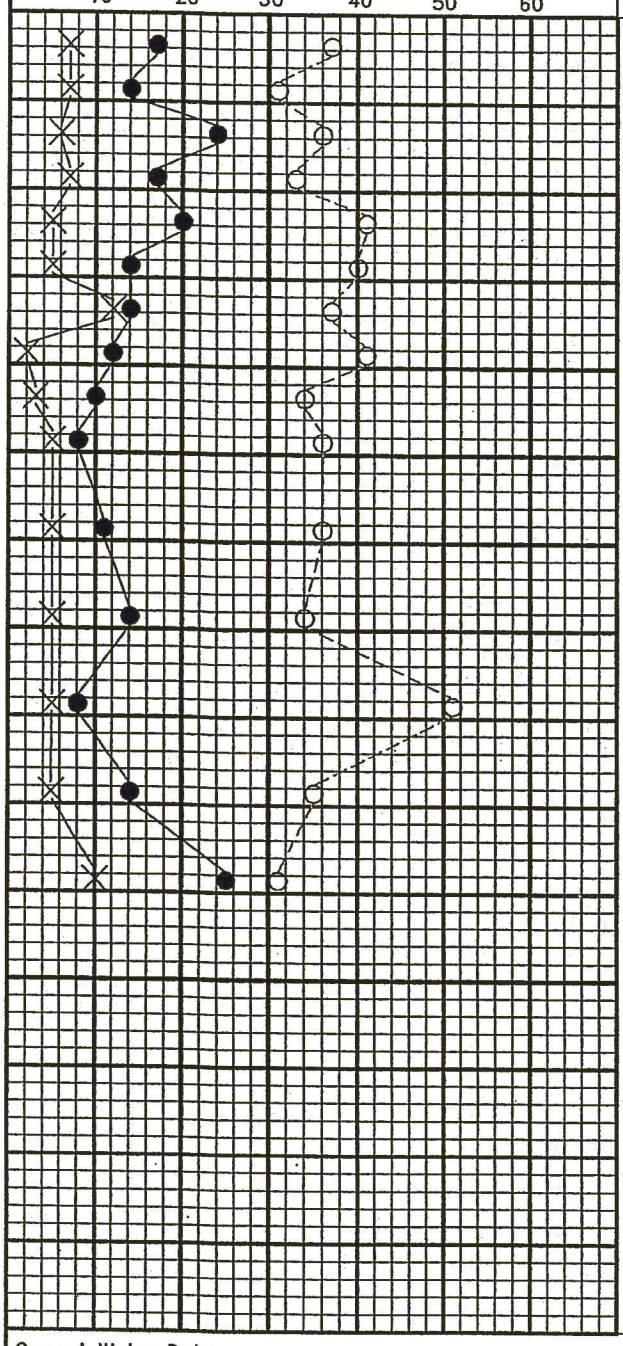
LOG of BORING 3



Depth in Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation
	1	ss		6" Topsoil
	2	ss		Brown Mottled Gray CLAY (CH) with sand
	3	ss		
	4	ss		Gray Mottled Brown CLAY (CH) with sand
10	5	ss		
	6	ss		
	7	ss		Gray Mottled Brown CLAY (CH)
20	8	ss		Gray CLAY (CH)
	9	ss		Gray CLAY (CH) with sand lenses
	10	ss		Gray Sandy CLAY (CH)
30	11	ss		Gray CLAY (CH) with sand lenses
	12	ss		
40	13	ss		
	14	ss		
	15	ss		
50				End of Boring @ −50.0'
60				
70				

Ground Water Data
Ground Water Encountered @ −24.0' During Drilling and Plugged Upon Completion.

Project: Proposed Waste Water Treatment Facility Murphysboro, Illinois	Date of Boring May 16, 2008
Client: J.T. Blankinship & Associates Murphysboro, Illinois	Project No. H−08086

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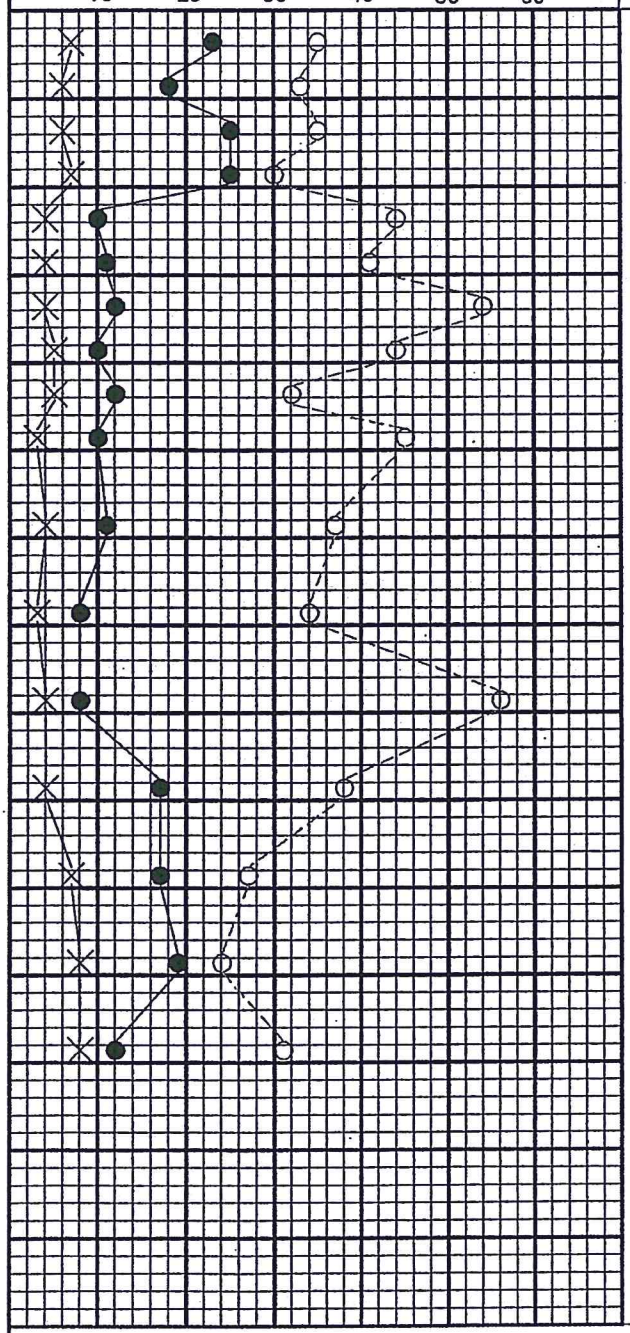
LOG of BORING 4



Depth in Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation
	1	ss		6" Topsoil
				Brown Mottled Gray CLAY (CH)
	2	ss		Gray Mottled Brown CLAY (CH) with sand
	3	ss		
10	4	ss		
	5	ss		
	6	ss		
	7	ss		Brown Mottled Gray CLAY (CH) with sand
20	8	ss		
	9	ss		Gray CLAY (CH) with sand lenses
	10	ss		
	11	ss		
30	12	ss		
	13	ss		
40	14	ss		Gray CLAY (CH) with sand
	15	ss		
50	16	ss		
	17	ss		
60				End of Boring @ −60.0'
70				

Ground Water Data
Ground Water Encountered @ −19.0' During Drilling and @ −33.0' Upon Completion.

Project: Proposed Waste Water Treatment Facility Murphysboro, Illinois	Date of Boring May 16, 2008
Client: J.T. Blankinship & Associates Murphysboro, Illinois	Project No. H−08086

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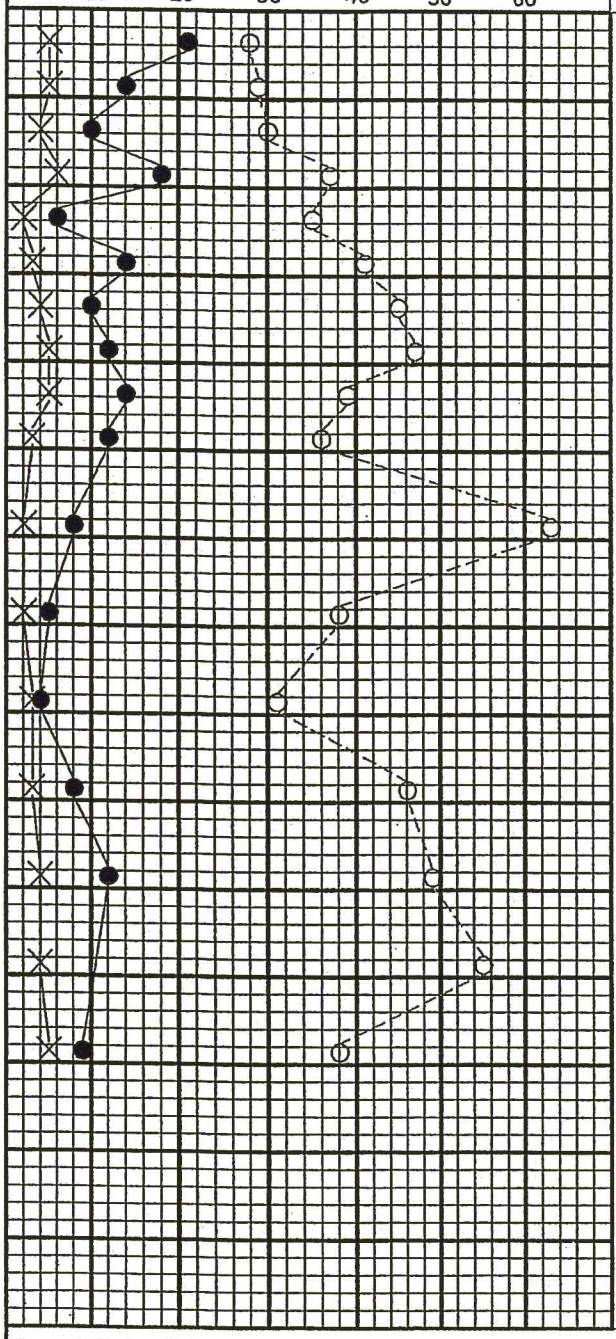
LOG of BORING 5



Depth in Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation
	1	ss		Brown Silty CLAY (CL) with sand
	2	ss		
	3	ss		Gray Mottled Brown Sandy CLAY(CL)
10	4	ss		Gray Mottled Brown CLAY (CH)
	5	ss		Brown Mottled Gray CLAY (CH)
	6	ss		with sand
	7	ss		Gray Mottled Brown CLAY (CH) with sand lenses
20	8	ss		
	9	ss		Gray CLAY (CH)
	10	ss		
30	11	ss		
	12	ss		Gray CLAY (CH) with sand lenses
40	13	ss		
	14	ss		
50	15	ss		
	16	ss		
60	17	ss		End of Boring @ −60.0'
70				

Ground Water Data
Ground Water Encountered @ −18.0' During Drilling and @ −11.0' Upon Completion.

Project: Proposed Waste Water Treatment Facility Murphysboro, Illinois	Date of Boring May 22, 2008
Client: J.T. Blankinship & Associates Murphysboro, Illinois	Project No. H−08086

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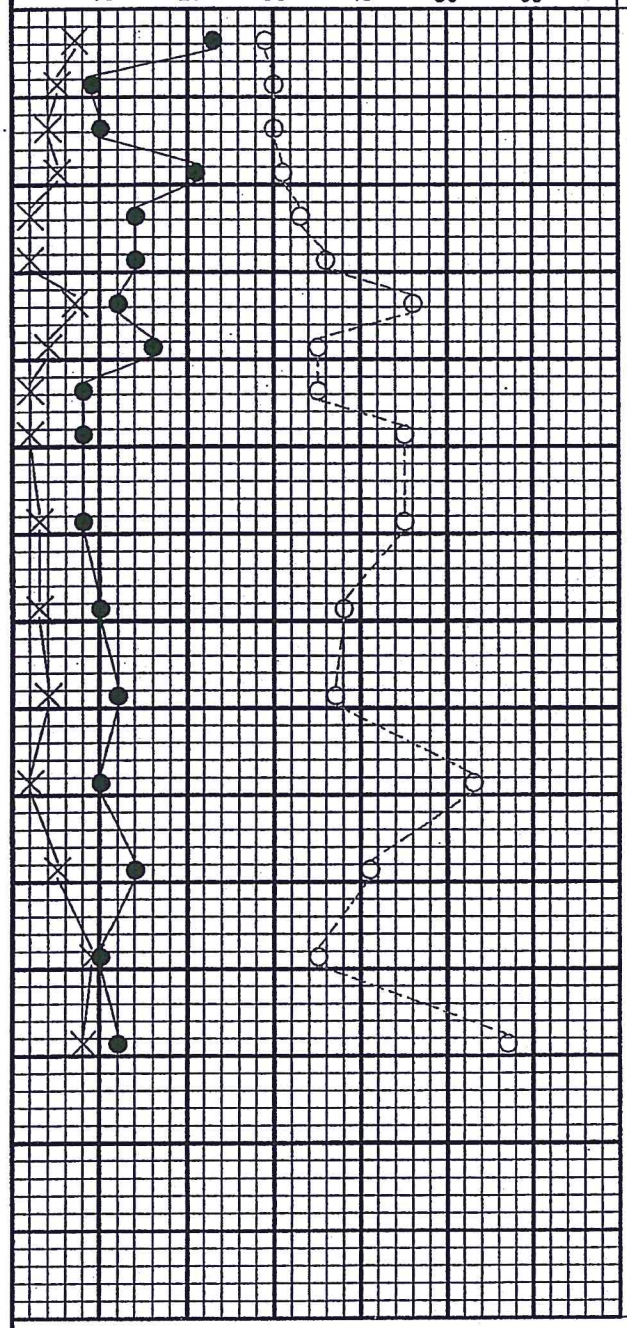
LOG of BORING 6



Depth in Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation
	1	ss		Brown Silty CLAY to Clayey SILT (CL–ML)
	2	ss		
	3	ss		Gray Mottled Brown Silty CLAY to Clayey SILT (CL–ML)
	4	ss		
10	5	ss		Gray Mottled Brown CLAY (CH)
	6	ss		
	7	ss		
	8	ss		
20	9	ss		
	10	ss		Gray CLAY (CH)
30	11	ss		
	12	ss		Gray CLAY (CH) with sand lenses
40	13	ss		
	14	ss		
50	15	ss		
	16	ss		
60	17	ss		End of Boring @ –60.0'
70				

Ground Water Data
Ground Water Encountered @ –12.0' During Drilling and @ –5.0' After 48 hrs.

Project: Proposed Waste Water Treatment Facility Murphysboro, Illinois	Date of Boring May 22, 2008
Client: J.T. Blankinship & Associates Murphysboro, Illinois	Project No. H–08086

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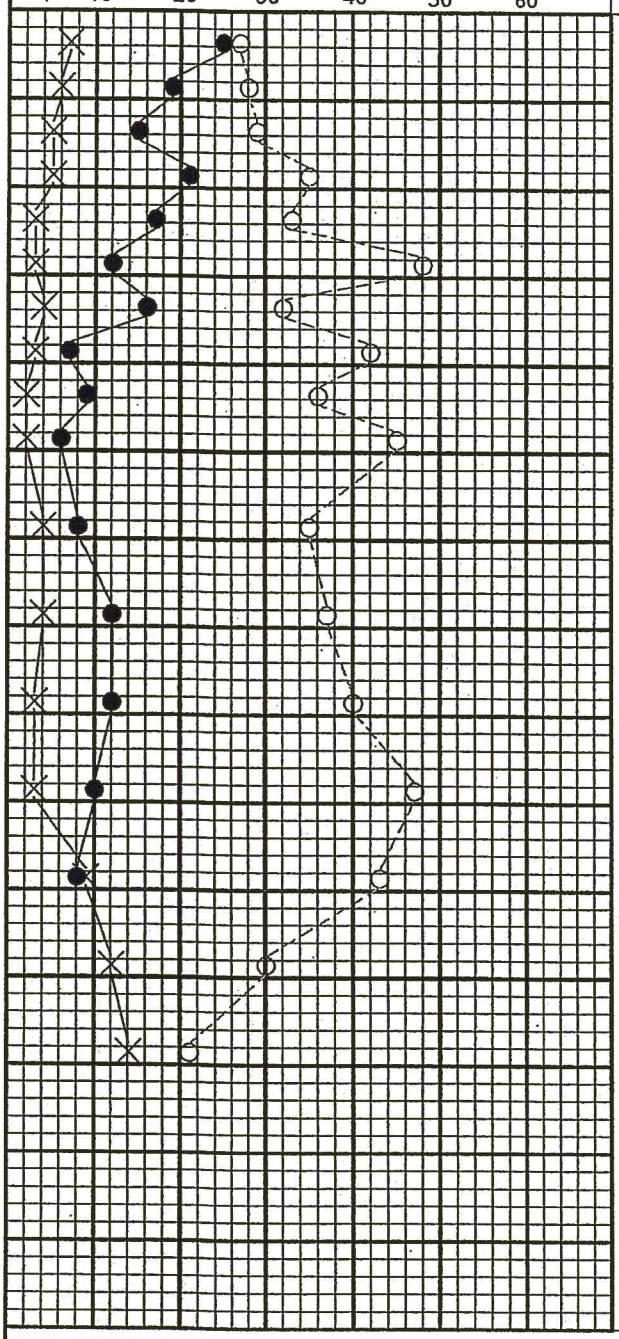
LOG of BORING 7



Depth in Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation
	1	ss		Brown Silty CLAY (CL)
	2	ss		Brown Mottled Gray Silty CLAY to CLAY (CL–CH) with sand
	3	ss		
10	4	ss		Gray Mottled Brown CLAY (CH) with sand
	5	ss		
	6	ss		
	7	ss		
20	8	ss		Gray CLAY (CH) with sand lenses
	9	ss		
	10	ss		
30	11	ss		
	12	ss		
40	13	ss		
	14	ss		
50	15	ss		Gray Sandy CLAY (CH)
	16	ss		Gray SAND (SP)
60	17	ss		End of Boring @ –60.0'
70				

Ground Water Data
Ground Water Encountered @ –20.0' During Drilling and @ –23.0' Upon Completion.

Project: Proposed Waste Water Treatment Facility Murphysboro, Illinois	Date of Boring May 21, 2008
Client: J.T. Blankinship & Associates Murphysboro, Illinois	Project No. H–08086

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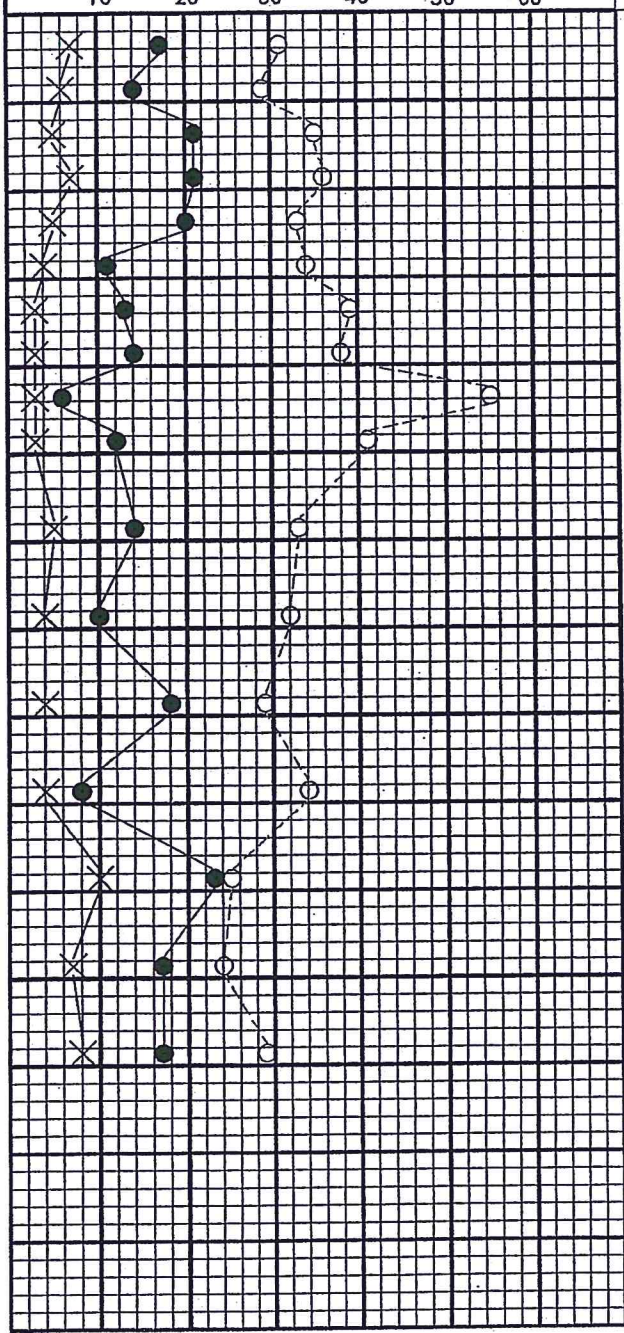
LOG of BORING 8



Depth in Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation
	1	ss		Brown Silty CLAY to CLAY (CL–CH)
	2	ss		Brown–Gray CLAY (CH) with sand
	3	ss		Gray Mottled Brown CLAY (CH) with sand
10	4	ss		
	5	ss		
	6	ss		
	7	ss		
	8	ss		Brown Mottled Gray CLAY (CH)
20	9	ss		Gray CLAY (CH)
	10	ss		
	11	ss		Gray CLAY (CH) with sand lenses
30	12	ss		
	13	ss		
40	14	ss		
	15	ss		
50	16	ss		
	17	ss		
60				End of Boring @ –60.0'
70				

Ground Water Data
Ground Water Encountered @ –21.0' During Drilling and @ –25.0' Upon Completion.

Project: Proposed Waste Water Treatment Facility
Murphysboro, Illinois

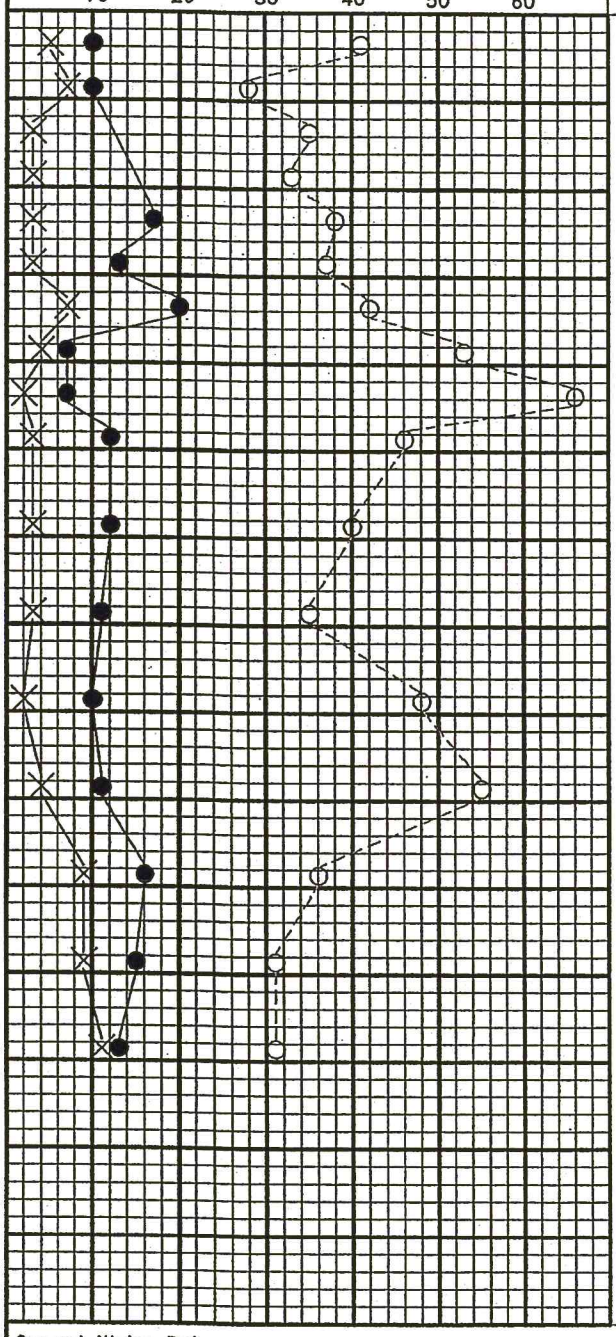
Date of Boring
May 21, 2008

Client: J.T. Blankinship & Associates
Murphysboro, Illinois

Project No.
H–08086

Holcomb Foundation Engineering Co.
PO Box 88 Carbondale, Illinois

LOG of BORING 9



Depth in Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation
	1	ss		6" Topsoil
	2	ss		Gray Mottled Brown CLAY (CH) with sand
	3	ss		Gray Mottled Brown Clayey SAND(SC)
10	4	ss		
	5	ss		Gray Mottled Brown Sandy CLAY(CH)
	6	ss		
	7	ss		Gray CLAY (CH) with sand
20	8	ss		
	9	ss		Gray CLAY (CH)
	10	ss		
30	11	ss		
	12	ss		
40	13	ss		
	14	ss		
50	15	ss		
	16	ss		
60	17	ss		End of Boring @ −60.0'
70				

Ground Water Data
Ground Water Encountered @ −11.0' During Drilling and @ −8.0' Upon Completion.

Project: Proposed Waste Water Treatment Facility Murphysboro, Illinois	Date of Boring May 19, 2008
Client: J.T. Blankinship & Associates Murphysboro, Illinois	Project No. H−08086

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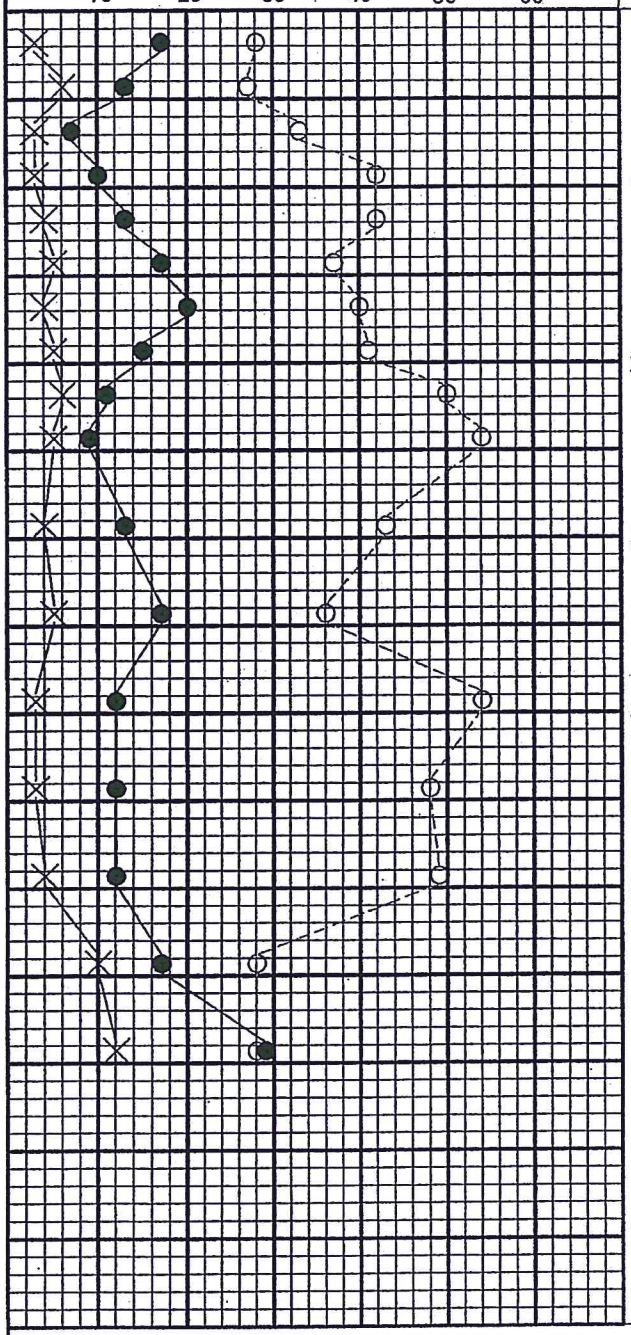
LOG of BORING 10



Depth in Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation
	1	ss		6" Topsoil
	2	ss		Brown Mottled Gray CLAY (CL) with sand
	3	ss		Gray Mottled Brown Silty CLAY to CLAY (CL–CH)
10	4	ss		
	5	ss		
	6	ss		Brown Mottled Gray CLAY (CH)
	7	ss		Gray CLAY (CH) with sand
20	8	ss		
	9	ss		
	10	ss		
30	11	ss		
	12	ss		
40	13	ss		Gray CLAY (CH)
	14	ss		
50	15	ss		
	16	ss		
60	17	ss		End of Boring @ –60.0'
70				

Ground Water Data
Ground Water Encountered @ –5.0' During Drilling and @ –13.0' Upon Completion.

Project: Proposed Waste Water Treatment Facility Murphysboro, Illinois	Date of Boring May 21, 2008
Client: J.T. Blankinship & Associates Murphysboro, Illinois	Project No. H–08086

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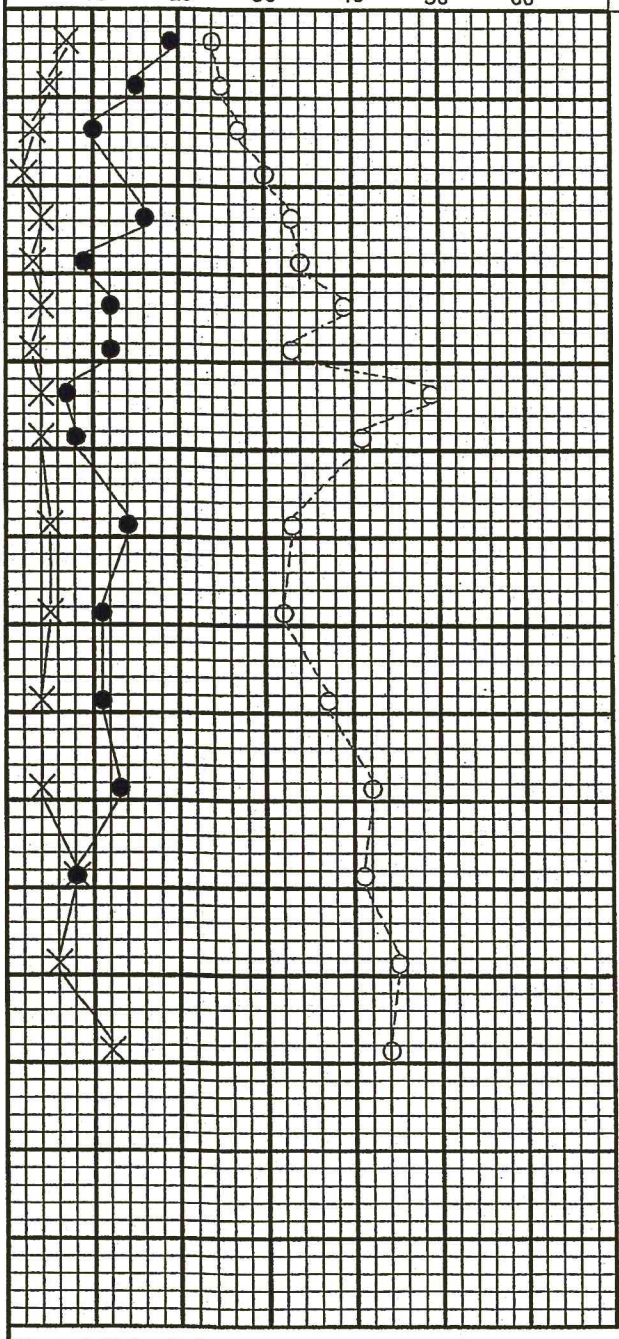
LOG of BORING 11



Depth in Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation
	1	ss		Brown Silty CLAY (CL) with sand
	2	ss		
	3	ss		Brown Mottled Gray Sandy CLAY(CL)
	4	ss		Gray Mottled Brown Clayey SAND(SC)
10	5	ss		Gray Mottled Brown CLAY (CH) with sand
	6	ss		
	7	ss		
	8	ss		
20	9	ss		Gray CLAY (CH) with sand
	10	ss		
	11	ss		Gray CLAY (CH)
30	12	ss		
	13	ss		
40	14	ss		Gray CLAY (CH) with sand
	15	ss		
50	16	ss		Gray SAND (SP) with clay and organics
	17	ss		
60				End of Boring @ −60.0'
70				

Ground Water Data
Ground Water Encountered @ −9.0' During Drilling and @ −7.0' Upon Completion.

Project: Proposed Waste Water Treatment Facility Murphysboro, Illinois	Date of Boring May 21, 2008
Client: J.T. Blankinship & Associates Murphysboro, Illinois	Project No. H−08086

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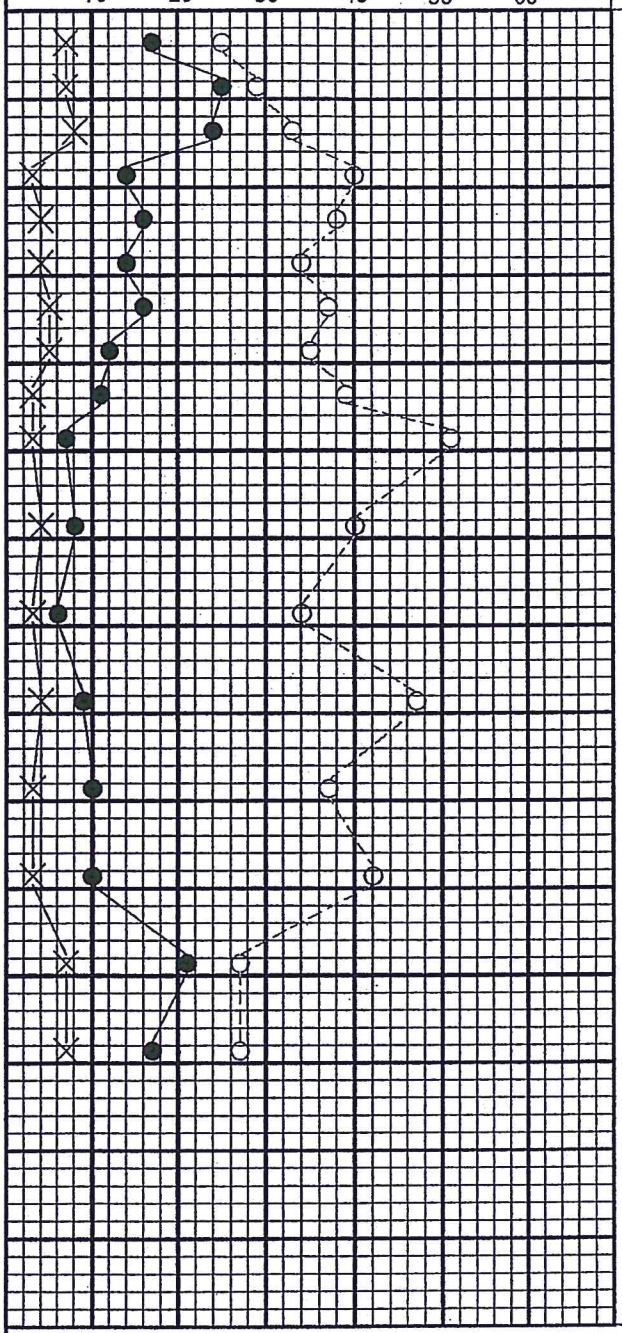
LOG of BORING 12



Depth in Feet	Sample No.	Type Sample	Sample Distance	Description of Material
				Surface Elevation
				6" Topsoil
	1	ss		Brown Mottled Gray Silty CLAY (CL) with sand
	2	ss		
	3	ss		Gray Mottled Brown CLAY (CH) with sand
10	4	ss		
	5	ss		
	6	ss		
	7	ss		Gray CLAY (CH) with sand
20	8	ss		
	9	ss		
	10	ss		Gray CLAY (CH) with sand lenses
30	11	ss		Gray CLAY (CH) with sand
	12	ss		
40	13	ss		
	14	ss		
50	15	ss		
	16	ss		
60	17	ss		End of Boring @ −60.0'
70				

Ground Water Data
Ground Water Encountered @ −16.0' During Drilling and @ −12.0' Upon Completion.

Project: Proposed Waste Water Treatment Facility Murphysboro, Illinois	Date of Boring May 19, 2008
Client: J.T. Blankinship & Associates Murphysboro, Illinois	Project No. H−08086

HOLCOMB FOUNDATION ENGINEERING CO., INC.

SOILS - BITUMINOUS - CONCRETE - INVESTIGATIONS AND TESTING

www.holcombengineering.com

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Carbondale, IL 62903

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FAX 618-457-8991

Atterberg Limits Test Results

Murphysboro Waste Water Treatment Plant
Murphysboro, Illinois

HFE File: H-08086
Date: 05-30-08

Boring/Depth(Ft.)	Liquid Limit(%)	Plastic Limit(%)	Plasticity Index	Soil Classification
Boring #1/ 3.5-5.0'	48.1	25.9	22.2	Silty CLAY (CL)
Boring #3/ 18.5-20.0'	71.5	24.4	47.1	Fat CLAY (CH)
Boring #9/ 33.5-35.0'	53.8	20.0	33.8	Fat CLAY (CH)

GENERAL NOTES

SAMPLE IDENTIFICATION

The Unified Classification System is used to identify the soil unless otherwise noted.

RELATIVE DENSITY & CONSISTENCY CLASSIFICATION

TERM (NON-COHESIVE SOILS)	BLOWS PER FOOT
Very Loose	0 - 4
Loose	5 - 10
Firm	11 - 30
Dense	31 - 50
Very Dense	Over 50

TERM (COHESIVE SOILS)	QU (tsf)
Very Soft	0 - 0.25
Soft	0.25 - 0.50
Firm	0.50 - 1.00
Stiff	1.00 - 2.00
Very Stiff	2.00 - 4.00
Hard	4.00+

DRILLING & SAMPLING SYMBOLS

ss:	Split Spoon - 1 3/8" I.D., 2" O.D.
st:	Shelby Tube - 2.80"I.D., 3" O.D.
au:	Auger Samples
cs:	Continuous Sampling - 2.0" I.D.

SOIL PROPERTY SYMBOLS

●	Unconfined Compressive Strength, Qu, (tsf)
+	Penetrometer Value, (tsf)
	Plastic Limit (%)
O	Water Content (%)
	Liquid Limit (%)
X	Standard "N" Penetration: Blows per foot of a 140 pound hammer falling 30 inches on a 2" O.D. Split Spoon

PARTICLE SIZE

Boulders	8 in. +	Medium Sand	0.6 mm to 0.2 mm
Cobbles	8 in. to 3 in.	Fine Sand	0.2 mm to 0.74 mm
Gravel	3 in. to 5 mm	Silt	0.074 mm to 0.0005 mm
Coarse Sand	5 mm to 0.6 mm	Clay	less than 0.005 mm

UNIFIED SOIL CLASSIFICATIONS

MAJOR DIVISIONS			SYMBOL	TYPICAL DESCRIPTION
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	CLEAN GRAVELS	GW	Well graded gravels, gravel-sand mixtures
			GP	Poorly graded gravels, gravel-sand mixtures
		GRAVELS WITH FINES	GM	Silty gravels, gravel-sand silt mixtures
			GC	Clayey gravels, gravel-sand clay mixtures
	SANDS AND SANDY SOILS	CLEAN SANDS	SW	Well-graded sands, gravelly sands
			SP	Poorly graded sands, gravelly sands
		SANDS WITH FINES	SM	Silty sands, sand-silt mixtures
			SC	Clayey sands, clay-sand mixtures
FINE GRAINED SOILS	SILTS AND CLAYS LOW PLASTICITY		ML	Inorganic silts of clayey silts with slight plasticity
			CL	Inorganic clays of low to medium plasticity
			OL	Organic silts and organic silty clays of low plasticity
	SILTS AND CLAYS HIGH PLASTICITY		MH	Inorganic silts of high plasticity
			CH	Inorganic clays of high plasticity
			OH	Organic clays of medium to high plasticity
HIGHLY ORGANIC SOILS			PT	Peat, humus, swamp soils with high organic contents